Ohio Agricultural Experiment Station.

BULLETIN 73

WOOSTER, OHIO, DECEMBER, 1896.

INVESTIGATIONS OF PLANT DISEASES IN FORCING HOUSE AND GARDEN.

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EXPERIMENT STATION, WOOSTER, OHIO.

NORWALK, OHIO:
THE LANING PRINTING CO.
1897.

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The Bulletins of this Station are issued at irregular intervals. They are paged consecutively, and an index is included with the Anuual Report, which constitutes the final number of each yearly volume.

BULLETIN.

OF THE

Ohio Agricultural Experiment Station.

NUMBER 73 DECEMBER, 1896.

INVESTIGATIONS OF PLANT DISEASES

IN

FORCING HOUSE AND GARDEN.

BY AUGUSTINE D. SELBY B. SC. BOTANIST.

During the last two years sundry studies of plant diseases have been made. These are by no means complete or exhaustive with respect to the culture plants here included, yet it seems best to present them in bulletin form. In this way they may prove more helpful than if held for greater completeness.

Forcing house culture is rapidly increasing, and some of the troubles of forced vegetables are quite serious. The Station greenhouses have supplied problems peculiar to this class of work, and inquiries from persons similarly engaged have added to the list of such diseases.

I. DISEASES OF LETTUCE.

1. LETTUCE ROT.

There have been frequent complaints of the destructiveness of the lettuce rot or blight, due to *Botrytis vulgaris* Fr.[1] The increased production of greenhouse lettuce makes the diseases of this plant of quite general interest, and while other diseases are noted below, the rot still takes first rank as a destroyer of lettuce. At this Station the head varieties have succumbed to the rot at every trial, while Grand Rapids, the variety more commonly grown, appears to be least susceptible to this disease. Simpson and the head sorts both suffered serious injury, the latter especially, while Grand Rapids, in the same house, has not been affected to any marked extent. The rot is a fungous disease, though

[1]Dr. A. B. Frank refers this to *Botrytis cinerea* Pers. Krankheiten der Pflanzen II, 497. 1896.

fungicidal treatment has not been successful, partly because a poisonous spray cannot be used on the leaves. Preventive measures against it appear, on the whole, to be the most useful. These include thorough sterilization of houses by cleaning and fumigation, the use of fresh earth each year and the careful regulation of temperature. Excessive watering is likewise a source of danger. The method of watering may play a most important part.[2]

The Station Horticulturist maintains and recommends a low night temperature, less than 50° F. Too high a temperature, especially at night when ventilation is not easily secured, is conducive to the development of the rot fungus. The necessity for thorough ventilation is generally recognized, and the inroads of rot during periods of low temperature and cloudy weather are frequently very serious. After the rot makes its appearance the rotted plants and leaves should be frequently gathered and burned.

2. A LETTUCE LEAF BLIGHT.

Early in the year complaint was received from the vicinity of Galion of a serious forcing house disease of lettuce, prevailing there. The affected plants show stunted and unsatisfactory growth, and later, numerous dead areas, 2–4 millimeters (approximately one-twelfth to one-ninth inch) in diameter, in the leaves. Where young plants are seriously attacked the margins and tips of the leaf become badly blighted and somewhat curled. The symptons in general are those of plants suffering from root disease, such as nematodes or other troubles, but no explanation has yet been found for the difficulty. No fungus appeared to dwell in the dead spots. Unlike the following trouble the midribs and veins of the leaves do not appear to be affected, and the dead areas do not fall out. Mention is here made of it chiefly with a view to securing further information upon the matter.

3. LETTUCE LEAF PERFORATION.

Specimens of diseased lettuce plants were received in March, 1896, from a grower at Troy, O. The trouble was described as first appearing in a narrow strip, running parallel to the side of one of the benches. Subsequently, affected plants appeared in all the houses where plants grown at the point of beginning had been transplanted. The diseased leaves showed numerous perforations, 1 to 2 millimeters or more in diameter, with irregular borders. Comparison of these perforations with the spots just forming seemed to show that a fungus had first attacked the leaves, the dead areas thus produced having afterwards dropped out. Examination of the border areas, with the microscope, showed the presence of a constant fungus form, also present in the incipient leaf spots

[2]Green, W. J., Bulletin 61, Ohio Agr'l Expt. Station, p. 64. 1895.

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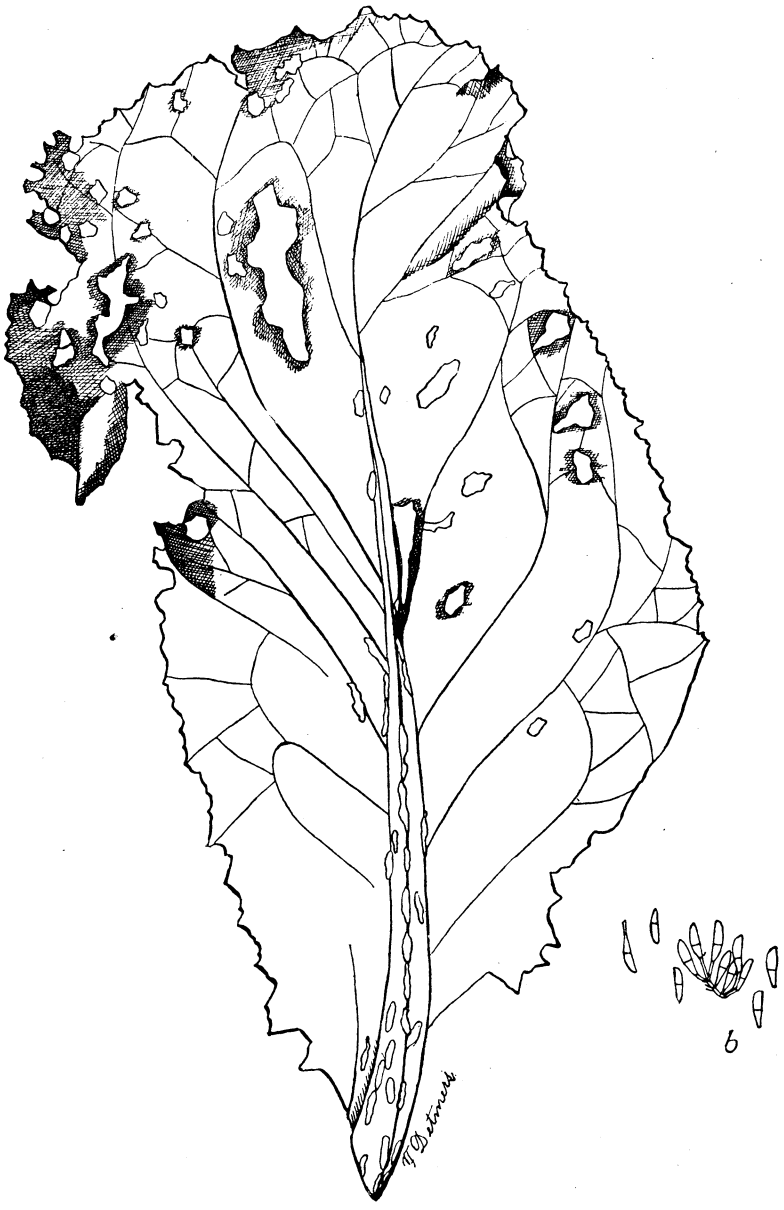

PLATE I. LETTUCE LEAF PERFORATION.

EXPLANATION OF PLATE I. This shows at *a* a diseased lettuce leaf suffering from the Leaf Perforation Disease.

At *b*. Spores and spore-bearing parts of the fungus, *Marsonia perforans* E. & E., highly magnified.

and depressed affected areas along the fleshy midrib of the leaf. The stems of the plants were affected by the same fungus, but there the spots were confluent and, usually, much elongated. The preliminary microscopic examination showed this to be apparently a new form—fungus as well as a new disease of this well known salad plant. Specimens were sent to Dr. J. B. Ellis who proposes the name *Marsonia perforans* E. and E., new species,[3] for the fungus. As will be seen from the name of the genus, this is but a form species, concerning whose complete state we at present lack knowledge.

The disease caused by this fungus appears to be characteristic and it is proposed to call it the Lettuce Leaf Perforation. The accompanying illustration, Plate I, will give some idea of the appearance of a fair sized, affected leaf and of the fungus spores. The smaller (younger) leaves are very much distorted and drawn toward the apex. The brownish spots on the under side of the leaf and along the midrib, together with the perforations left by the deciduous, dead areas, all shown as light and unshaded in drawing, appear to be the most characteristic symptoms of this new fungus disease. Of necessity microscopic examination will be relied upon to render final decision.

Of the injuries likely to result from the leaf perforation disease, no exact statements can be made at present. Judging by the appearance of the affected plants seen, one would infer that few plants once attacked could recover. The damage wrought in this case would depend altogether upon the prevalence of the trouble. It is, however, to be regarded as a serious affection of greenhouse lettuce; there appears to be no record of a similar trouble out of doors.

The following correspondence from Mr. Skinner, in whose house the trouble appeared, will serve to throw some light upon the damage caused by the trouble as well as give hints upon handling it.

Under date of March 11, 1896:

"I find the quickest method of spreading the disease is by watering. I now water carefully and keep the house well ventilated, day and night. I have also used sulphur and oil on steam pipes. I have had some difficulty in getting a spray pump, so have been unable to spray yet. I can see no increase in diseased plants since adopting the above method, while there has been a marked improvement in the sick ones."

Later he writes:

TROY, O., March 17, 1896.

Your favor of the 14th received. I find it rather difficult to determine, with any degree of accuracy, the amount of damage done by the disease. A great many

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[3] *Marsonia perforans* Ellis and Everhart, *sp. n.* Spots small, irregular in shape 1-2 m. m. in diameter, pale soon deciduous. Acervuli 100-120 *u* in diameter, or by confluence larger. Conidia abundant, clavate or wedge shaped, hyaline, faintly uniseptate 11–15x2½–3 *u* exceptionally reaching 20 *u* long.

On cultivated lettuce (Lactuca sativa) in a greenhouse, Troy, Ohio, March, 1896. Comm. Prof. Aug. D. Selby.

plants are seemingly all right on top, but the lower leaves are badly affected. I think that fully 3,000 plants are diseased more or less. I have about 15,000 planted. I don't think I shall ever be caught this way again. As I said in my last letter, I think the spread of the disease is due to surface watering. The water seems to wash off the germs to adjacent lettuce, but I find it also spreads through the atmosphere, as it has spread from one bench to another.

I think it will not be difficult to manage with sub-irrigation, as I have one bench, one-half of which has never been sprinkled, while the other half has had repeated surface waterings. The sub-irrigated side, while it had diseased plants in it, seems to have spread scarcely any, while the other half is badly affected.

I am putting in tile for sub-irrigation as fast as the lettuce is taken out, and in the meantime am watering under the leaves by means of a perforated iron pipe. I find affected plants looking much better than a few days ago.

I send you half a doxen more plauts to-day. I am very thankful for your kind advice and information.

Yours truly,

C. W. S.

4. DOWNY MILDEW OF LETTUCE.

This disease, caused by a fungus (*Bremia Lactucæ* Regel.), of the same order as the downy mildew of the grape (Peronospora) prevailed in the Station greenhouses at Columbus in 1891. It was there quite destructive.

Affected leaves show rather large, and usually scattered, yellow or dead areas, when seen from above; from below the downy, mildewed appearance, on the borders of these spots, will render identification possible. The diseased spots are often irregular and, commonly, bounded by the leaf venation. The downy mildew spreads quite rapidly under favorable conditions, such as are furnished in surface watered greenhouses. Moisture upon the leaves and a moist atmosphere induce the growth of the fungus spores and of the fungus threads, where already started. In the case at the station, sub-irrigation greatly helped; in this method the plants and soil surface remain dry. The removal of diseased leaves will, usually, repay the labor. But it is worth bearing in mind that lettuce in the greenhouse does not require a high temperature. Proper attention to heat and moisture may be expected to yield the desired results with the downy mildew.

5. OTHER LEAF SPOTS.

The weedy, prickly lettuce is attacked by a leaf spot fungus (Septoria[4]); the same or a similar trouble is reported upon lettuce in garden culture. In such cases attention to removal of sources of infection and destruction of affected parts may give all relief needed.

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(4) Detmers F. Bulletin, 44 Ohio Experiment Station, 1892 p. 145

II. DISEASES CAUSED BY NEMATODES.

A great many cases of nematode diseases of greenhouse plants have come under notice during the past year. These minute, parasitic worms, of microscopic size, called also eelworms, cause serious derangements of the normal life functions of the plant. In all instances examined, the nematodes were upon the under ground parts, or upon the stem near the surface of the earth, yet the attributed effects upon the different plants are extremely variable. Where the eelworms attack the small rootlets, minute enlargements, or galls, are produced, and in those the parasites and their eggs are found. Where the stems and larger roots are affected, large, gall-like excrescences are sometimes formed and the nematodes are within them. Small excrescences were noted upon roses, tomatoes, burdocks, *Begonia metallica*, *Begonia rubra*, cucumbers, violets, Abutilon, Passiflora and apples; the large ones with indwelling eelworms were found upon *Begonia rubra*, *B. olvia*, apples, raspberries and upon blackberries, as described elsewhere. The same offender was also discovered upon the stems of lettuce near the ground, but caused no apparent check to growth. The differentiation of species of eelworms has not been attempted, but the forms observed are all very similar in superficial aspects, if not identical as to species. They are referred to Heterodera.

NEMATODE SYMPTOMS.

The symptoms of nematode attack manifested by the plant are, some of them, quite clearly marked. Stunted or insufficient growth is commonly noticed in the early stages. Later, the leaf symptoms especially, are usually characteristic, and with some experience commonly distinguishable from the spots due to parasitic fungi upon the leaves. The length of time to elapse before particular symptoms are disclosed depends somewhat upon the vigor of the plant attacked. In the greenhouse benches at the Station, where roses were grown in surface watered and sub-irrigated sections alongside each other, the surface-watered plants were much smaller and less vigorous; they often succumbed quite suddenly to the eelworms, with but slight general yellowing of foliage. The eelworm attack shows itself more commonly in the dying of the leaves at the point or on the lateral margins, or both, with usually a scalded aspect. The whole plant may collapse in a single day. Upon the vigorous, sub-irrigated rose plants affected with nematodes there was a decided yellowing of the leaves; frequently the trouble is called "the yellows." The later stages, with these as with the smaller and less vigorous, are accompanied by the dying of the leaves from the borders and by final more or less sudden collapse.

With tomatoes the leaves fail to reach full development, tend to recurving of margins toward the tip, and show numerous, small, dead spots

within the leaf. The tips of shoots also die back. The symptoms in affected begonias are similar to the leaf symptoms for roses, except that in no case observed has there been sudden collapse of the plant. The begonia leaves died slowly from the margins toward the petiole, the points of the stem died, while the evidences of serious debility were most marked.

In forced cucumbers the first noticeable symptom is stunted growth, followed by dying of lower leaves, first at the point and then the whole leaf. Soon after this begins the entire plant wilts down suddenly and dies.

The illustrations, Figs. 1 and 2, Plate II., of affected cucumber plants with the guilty parasities, are from specimens obtained in forcing houses in Hamilton county, in December, 1895. This grower had suffered severely from this trouble. The sod for soil was taken fresh, placed in the benches and utilized without winter handling and freezing.

Whenever the plants affected by nematodes are taken up and root examinations made, the excrescences become apparent. Where the cause of leaf trouble or stunted growth is in doubt, root examination[5] will disclose the marks of nematodes if these are present. The illustrations show these more clearly than can done by descriptive matter.

Along with the large galls upon *Begonia rubra*, mentioned in connection with nematodes, and indeed upon the excrescences themselves, a parasitic fungus was discovered. It is a species which seems to be rarely met with, the conidial forms of *Thielvia basicola* Zopf.[6] Thaxter[7] has reported the same fungus upon roots of violets in this country.

If the past year may be taken as an indication, the nematode problem is a most pressing one for greenhouse culturists and may have further application as well. That the beet nematode of Europe is a serious field pest may well be kept in mind.

In greenhouse culture the nematodes appear to be traceable to incompletely rotted and partly disintegrated sod, or otherwise affected earth, used in benches, or to too fresh manure used in composting. No methods of treatment have been thus far successful in curing nematode sick plants. Small experiments with remedies were carried out in 1895. Potash salts, such as muriate of potash and kainit have been suggested[8] likewise manganese salts[9], (sulfate of manganese and permanganate of potash). Trials of these were made on roses through the co-operation of the Station Florist, W. A. Porter. They were begun early in March. The muriate of potash and kainit gave no marked evidences of beneficial

[5] The value of this examination may be overlooked. I found a violet grower spraying for leaf disease, where the dying leaves showed the usual marks of eelworms and the roots were beaded with nematode galls. In that case the fungus trouble did not show itself at all.

[6] Zopf' Die Pilze pp. 97 and 113.
Frank, Krankheiten dier Pflanzen, 1896, II, p. 278.

[7] Report Conn. Exp. Sta., 1891, pp. 166 and 167.

[8] Halsted, Byron D. Report Botanist 1892, 384.

[9] Humphrey, J. E. Report Mass. State Exp. Sta. 1889, 230.

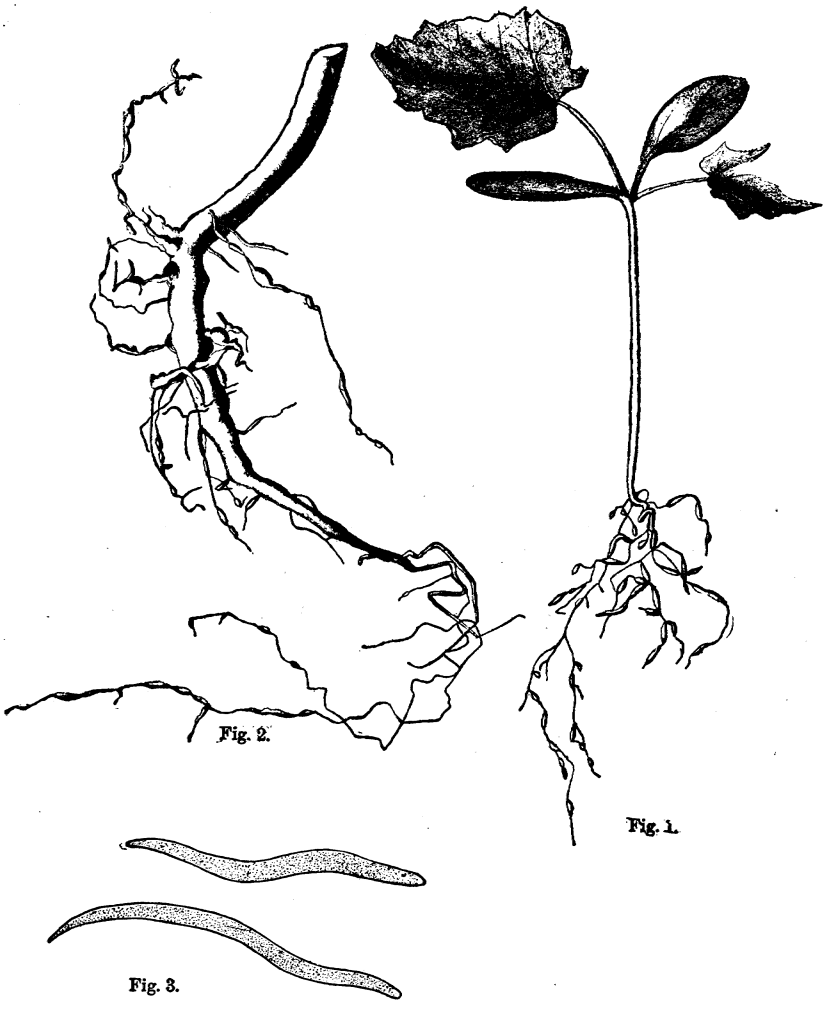

PLATE II. FORCED CUCUMBERS WITH NEMATODES.

FIG. 1. Small seedling cucumber plant, with the nematode galls upon rootlets. Natural size.

FIG. 2. Root of full-grown plant similarly affected. Natural size.

FIG. 3. Two nematodes or eel-worms, magnified 130 diameters.

Drawings by Miss F. Detmers.

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effect on rose plants attacked by nematodes. The sulfate of manganese[1] and potassium permanganate[10] did show an apparent stimulating result upon such affected rose plants as were watered by sub-irrigation; where surface watering in benches was used, no apparent re-action was noted. Lime water, similarly applied, has also a stimulating effect on sub-watered roses, likewise air slaked lime applied to the soil. Any stimulant may at times prove useful and profitable, since the nematode trouble, especially on roses, culminates when no other crop can well be used to replace the diseased plants. Curatives for nematode troubles do not appear to have been discovered.

The greater injury caused by these small worms in warmer climates, where the earth is not partly sterilized by winter freezing, suggests preventive care in the preparation of soil for use in the greenhouse. Sod may be piled up early, watered, if necessary, to induce rotting, and cut down in fall and winter, with handling, to attain thorough freezing. In the same manner better disintegration of sod is secured; this, with the selection of only old, well rotted manure, should give some relief. Piling sod two years before it is to be used may be impracticable, yet it is to the earth employed and to the fertilizer that the culturist under glass must probably look for greater immunity from nematode troubles.

Sterilization of composted soil by other means, as by heating and steaming have been proposed. Mr. Lodder, of Hamilton county, whose serious losses from nematodes in cucumber forcing in 1895 have already been mentioned, has tried steaming the soil with apparent good results in 1896. Since others may wish to try the same method a part of a letter just received from him, in response to an inquiry and bearing date of December 17, 1896, is here inserted:

"Your letter of December 14th is at hand. I will gladly give you all the information I can regarding my method of steaming soil, etc. The box used is 20 feet long, 6 feet wide and 5 feet deep, with good sides, solid bottom and good cover for the top. [This sets upon the ground as I understand it. A. D. S.] The floor of the box is raised one foot from the ground, the floor being made of 1¼ inch pipes, laid close together, and is open at both ends, [i. e. the floor is shorter than the box.] A little straw is put upon the pipes to keep the dirt from sifting through.

The main steam pipe, perforated, runs lengthwise below the floor; it has ¼-inch openings every foot and with ends open; size of the pipe 1¼ inches. When the box is filled with earth, covered and steam turned on, I run it for four hours with 40 pounds of steam and for three hours with 60 pounds of steam and then the dirt is cooked. This will cook a potato any place in the box. I have had no signs of insects [eelworms] whatever, and as far as I can see when the dirt is cooked [steamed] it is as rich as the manure, since the roots do not grow into the small lumps of manure as they do in the uncooked dirt. * * * I have had no more trouble with the downy mildew [on cucumbers]; the best thing I found to do for it, was to keep the plants a little more dry. * * * I find a little trouble with my young cucumber

[10]Both of these were used at the rate of one ounce of the salt to eight gallons of water, and one gallon of the solution once a week, to eighteen plants by surface watering.

plants, as they grow very slowly and are weak; yet there is no trouble on the roots and no mildew. * * * Trusting to hear from you again, I am,

Yours very respectfully,

FRED J. LODDER.

Essentially the same method of steaming soil is accredited to a western florist in 1893.[11] He steamed the soil to destroy grubs, insect larvæ and fungus spores.

The process of soil sterilization by steam, as before described, is an expensive one, but the cost may be well covered by losses from eelworms in forcing cucumbers, growing roses under glass and in some other cases. Further development along this line is desirable. In steaming or "cooking" soil, as noted by the correspondent quoted, the possible effect in causing it to cohere or run together needs to be guarded against. There is, also, an open probability of occasional failure to sterilize completely.

III. LEAF MILDEWS AND SPRAYING WITH FUNGICIDES UNDER GLASS.

The powdery mildew of composite plants (*Erysiphe Cichoracearum*, DC.) which spots many species, has been successfully combatted upon Cinerarias, where taken before the mildewed spots were very large, by spraying with either potassium sulfid solution, 1 oz. to 3 gallons of water, or with weak copper sulfate solution, 1 oz. to 3 gallons. Three or four sprayings have been sufficient. This mildew also affects forced cucumbers, and should be amendable to the same treatment.

Spraying carnations, in the greenhouse, has been undertaken, chiefly with reference to carnation leaf spot (*Septoria Dianthi* Desm) and leaf mold (*Heterosporium echinulatum* B.). In this, Bordeaux mixture, 75 gallon formula, made of 4 pounds of copper sulfate and 4 pounds unslaked lime to 50 gallons of water, and dilute solution of copper sulfate, 1 oz. to 8 gallons of water, have been used, and the carnations sprayed about once in two weeks. The results to date show a favorable influence upon the plants which were treated with Bordeaux, and no unfavorable effects are apparent from the other spray. A part of these, as well as trials of Fowler's solution for carnation rust, were made in cooperation with the Station Florist. Thus far no decided gain has come from spraying for rust with Fowler's solution.

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[11] W. N. Rudd, Mt. Greenwood, Ill., American Florist IX, 171, September 28, 1893. For method used to destroy nematodes, see American Florist X, 1038, September 11, 1895. These references were kindly supplied by W. A. Porter, Station Florist.

IV. DISEASES OF CUCURBITS.*

At least one serious disease of muskmelons and one each of cucumbers and watermelons have come under observation in the past two seasons. Other diseases of this class of plants are made the subject of inquiry at the hands of the Botanist.

1. BACTERIAL BLIGHT.

In common with other cucurbits, pumpkins, muskmelons, watermelons, etc., cucumbers suffer from a bacterial disease or wilt[12], the organism of which Dr. E. F. Smith has named *Bacillus tracheiphilus.*

The symptoms of blight are sudden wilting as from lack of water. Such collapsed plants show a moist, watery appearance of the inner stem tissue, near the surface of the ground. The inoculation of healthy plants has been shown to occur by the presence of the cucumber beetle (Diabrotica) and the squash bug (Coreus). No remedy has been devised for this trouble. To avoid following one susceptible crop by another is founded upon established principles. Burning affected plants as discovered, likewise decreases chances of infection. The destruction of the insects named is also necessary.

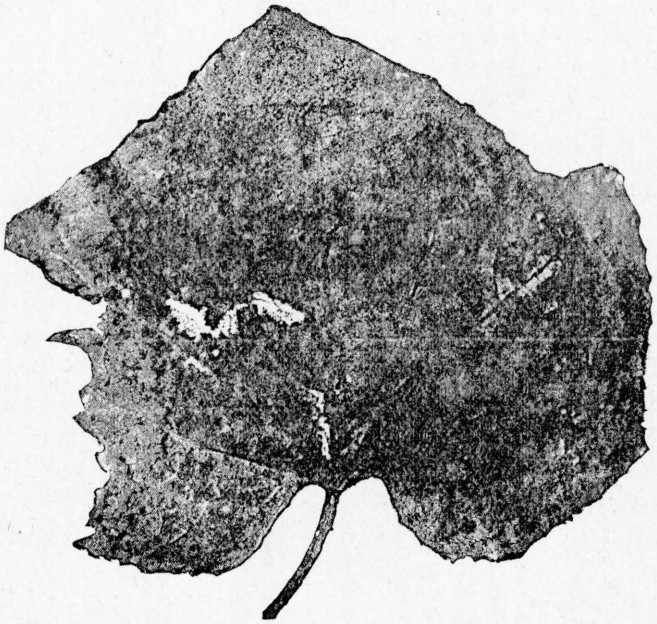

*Fig. 1 CUCUMBER LEAF WITH DOWNY MILDEW. (After Halsted.

*The writer presented a paper upon Some Diseases of Tomatoes and Cucurbits before the Columbus Horticultural Society, November, 1896. It will be found in the Society's Journal, December 1896. Some matters there noted do not appear in this bulletin.

[12]Proceedings A. A. A. S. 1893; Botanical Gazette September 1893: Centralblatt für Bakt. ü. Parasitenk. Zweite abt. II, 364. (1895).

*Cut from New Jersey Experiment Station.

2. DOWNY MILDEW OF CUCUMBERS.

The downy mildew of cucumbers (*Plasmopora Cubensis* B. & C.) Humph. See Fig. 1, prevails in forcing houses and has, likewise, appeared in Ohio gardens, notably my own at Wooster. A reference to the management of the downy mildew in greenhouses will be found in the letter, page 231. The fungus grows upon the under leaf surface, with outside growth; the threads of the parasite penetrate and rob the leaf tissue, causing spots as shown in the cut. We will refer to spraying further on. The treatment for the mildew, likely to be the most satisfactory in forcing houses, is suggested by Mr. Lodder.

The powdery mildew of cucumbers has been referred to on page 232.

3. CUCUMBER SPOT AND ANTHRACNOSE.

The cucumber spot (*Cladosporium cucumerium* Ell. and Arth.) upon the fruit, described by Dr. Arthur[13] several years ago from Geneva, N. Y. where it ruined the crop for pickling, has come to the Station from Mahoning county, Ohio. The appearance of the cucumbers is, perhaps, more damaged than the flavor. The pickle growers may find this disease a serious drawback. Fungicides, especially Bordeaux mixture, should prove available in reducing the spot.

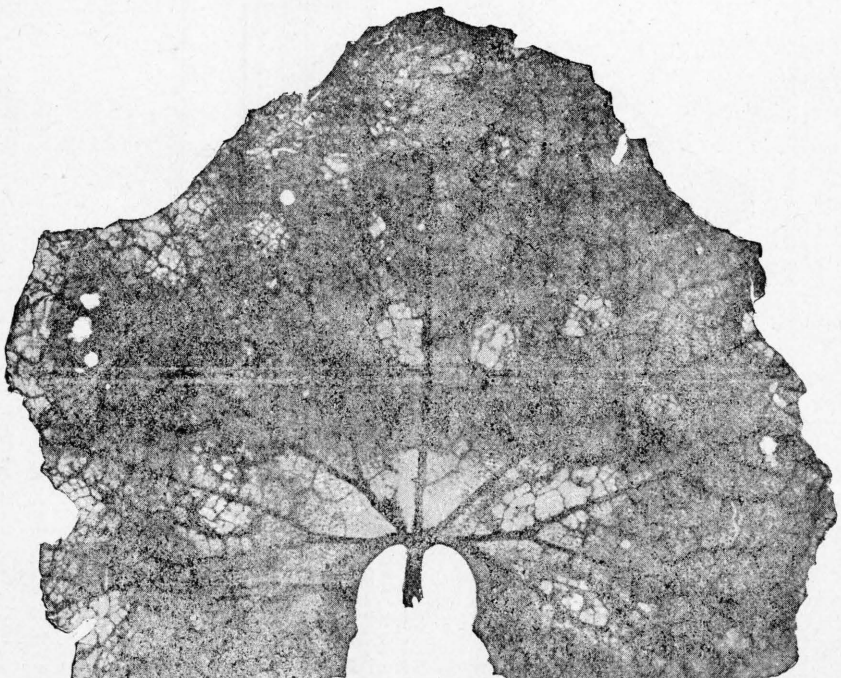

*FIG. 2. CUCUMBER LEAF BADLY ANTHRACNOSED. (After Halsted.)

[13]Bulletin 19, Indiana Expt. Sta., 1889.

*Cut obtained from New Jersey Experiment Station.

The Anthracnose (*Colletotrichum lagenarium* Pass.) (Fig. 2) another disease of both fruit and leaves, prevails in the east. In New Jersey it is described[14] as "probably the worst fungous enemy to cucumbers in the state." The anthracnose causes serious decay of the cucumbers when the fruit is attacked. It is likely to be found with us, since the same fungus that causes it is already spotting beans and watermelons.

REMEDIES.

Dr. Halsted gives encouragement in the following brief summary:[15]

"Cucumbers may be treated, with fungicides, for the anthracnose and (downy) mildew with reasonable hope of success.

"Bordeaux was the best substance employed in these experiments, and it not only increased the yield largely, but preserved the fruit from rotting."

4. NEMATODES ON FORCED CUCUMBERS.

The illustration, Plate II, shows the effects of nematodes or eel-worms upon forced cucumbers. This trouble was very serious, in at least one instance cited. The symptoms, in detail, will be found on page 228. The small, bead-like enlargements produced by the microscopic worms upon the roots of affected cucumber plants, will show that they are present. The remedies suggested for nematodes in general will apply here.

5. A PHYLLOSTICTA ON CUCUMBERS.

A pycnidial fungus, referred to Phyllosticta, has been found on diseased, spotted cucumber leaves, from Hamilton county. The small spore cases, appear as pin-head, dark spots on the surface of the dead areas in the diseased leaves.

6. A NEW LEAF BLIGHT OF MUSKMELONS.

The bacterial disease of muskmelons was mentioned under cucumbers. It has proven destructive at most points in the State. In addition, a new leaf blight of muskmelons made its appearance in the Station gardens during the season of 1896; apparently it has been in the region for two seasons. The fungus associated with it appears to be a species of Alternaria, (possibly that called by Peglion, [16] *A, Brassicae* (Berk.) *f. nigrescens* Pegl.)

This is apparently the same disease mentioned by Smith [17] as occurring in southwestern Michigan in 1892. At the Station, the past season, the plants were, practically, all dead before frost came and the crop was shortened.

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[14] Halsted, Dr. B. D. Report of Botanist of N. J. Expt. Sta., 1894, p. 347

[15] Report botanist, N. J. Expt. Sta., 1895, pp. 304-5.

[16] Peglion V. "Contribuzione alla conoscenza della flora micologica avellinese." See Zeits. für Pflanzenk. V. 293 (1895.)

[17] Smith, E. F. Jour. Myc. VII, 373. (1894.)

The fungus, Fig. 3, causes many rather large dead spots in the leaves, followed by dying and curling under from tip and margins. The last portion remaining green is between the leaf veins next the leaf stock. The leaf blight may not appear as early as the bacterial blight or "wilt," but it promises to be very injurious in its season. Bordeaux mixture promises most, should any one contemplate spraying for the leaf blight.

FIG. 3. ALTERNIA LEAF BLIGHT OF MUSKMELON.

The affected leaf is shown natural size in the figure; the spores and fungus threads magnified 52 diameters. From drawings by Miss F. Detmers.

7. ANTHRACNOSE OF WATERMELON.

Dr. Halsted has found the anthracnose fungus of the water melon to be identical with that of the bean and cucumber (*Colletotrichum lagenarium*) (Pass.) [18]

In cases of severe attack, this disease leads to decay of the melons. As seen the past season at Wooster, the spots were chiefly small and the damage accordingly less. These spots were in the melon rind and enlarged with age. The resemblance to other anthracnoses, as of the grape and raspberry, will suggest itself to the observer.

V. TOMATO DISEASES.

With tomatoes, as with cucumbers, the disease question appears in both forcing house and garden, yet it does not seem easy to divide the troubles squarely along these lines. The diseases first described have been prominent in the Station forcing houses.

1. TOMATO LEAF MOLD.

Tomato leaf mold (*Cladosporium fulvum* Cooke,) is the most common fungous disease of tomatoes grown under glass. This made serious inroads in the State greenhouses in 1891, when it was introduced from an old plant carried over. The disease first appears as rusty brown patches on the under side of the leaves; as these areas enlarge the leaf becomes yellow, wilts and finally dies. In cases of severe attack the whole plant may perish, and in any case, serious check to growth and development will follow.

Sturgis [19] recommends the use of Bordeaux mixture or copper carbonate to check leaf mold, but no results of actual experiments have come under notice. Dilute copper sulfate solution, (one pound to 150 or 200 gallons of water,) might be an effective spray. But in spraying tomatoes the great difficulty in securing adhesion of the liquid to the leaf would indicate Bordeaux mixture as the best fungicide for this crop.

With the leaf mold, as with lettuce rot, thorough ventilation is required.

2. A BLIGHT OF FORCED TOMATOES.

An obscure disease of greenhouse tomatoes caused much anxiety at the Station in the spring of 1895, and specimens of the same trouble have been received for examination; it also reappeared in 1896. This trouble shows itself as a general blighting of the plants attacked, and exhibits much the same symptoms as the winter blight described in Bulletin No. 43 of the Experiment Station of Cornell University. In the present case the younger leaves showed earliest indications of the disease, and had a drooping appearance, with the leaflets turned inward at the margin and occasional dead areas.

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[18] Report of botanist N. J. Expt. Sta. 1893, pp. 341-351.
[19] Sturgis, W. C., Bulletin Conn. Exp. Station. No. 111, 1892, p. 15.

This is shown in a fair degree in Plate III.

The attacked leaves soon die and hang from the more or less drooping leaf stock. The thriftiest and most vigorous plants were apparently as commonly attacked as the others; the later plantings suffered most. The stems and leaf stalks of the affected plants showed blackened, elongated spots upon them. In the houses where this trouble prevailed the green fruits were marked with dark brown, irregular spots of varying diameters as shown in Fig. 4.

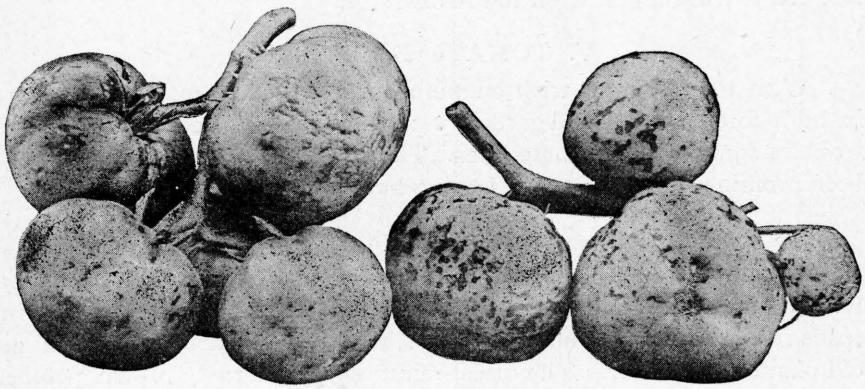

FIG. 4 GREEN TOMATOES SPOTTED BY BLIGHT.

It was noted, however, that only a portion of the plants with diseased foliage had the spotted fruit, while plants apparently healthy and with no indication of disease on the foliage, sometimes bore marked fruit. As the fruit ripened, the contrast in color, shown in the illustrations, became less apparent, and while some of it failed to mature, a portion was marketed as "seconds." For this blight no cause is at present assigned and no organisms were found associated with it. The leaf symptoms before described are very similar to those produced by nematodes or eelworms affecting the roots of tomatoes, also observed upon some plants carried over summer. The presence of the nematodes is shown by the enlargements or excresences they cause upon the roots attacked. But examination of the roots of the plants affected with this form of winter blight fails to show any nematode galls.

No very successful remedy or preventive has been found for this disease, but the prompt removal of the affected plants is strongly recommended. Where the plants were attacked late in the season, excision, performed by the use of a sterilized knife, proved fairly successful, but with younger plants the better practice is to remove at once and burn, replanting if it seems advisable.

With nematodes, just mentioned, great injury to tomatoes in the greenhouse appears unusual. This plant seems to grow too quickly, or to respond too slowly to eelworm attacks, to suffer severely from them.

PLATE III. A BLIGHT OF FORCED TOMATOES.
View in Greenhouse Bench, Wooster, in Spring of 1895.

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The planting of peas as bait plants might be a useful practice, the peas later to be removed and burned.

Other preventive measures will be found under the nematode discussion in this bulletin.

3. TOMATO LEAF BLIGHT—A NEW ARRIVAL.

An apparent new arrival, the tomato leaf blight, which also attacks the stems, has come to notice during the season of 1896. The fungus causing it [20](apparently referable to *Septoria Lycopersici* Speg.) is certainly capable of inflicting considerable injury upon the tomato grower. The appearance of diseased leaves, and the characters of the fungus producing it, are shown in Plate IV. The trouble, which begins at the end of the tip leaflet, was noted first in the Botanist's disease garden at Wooster, and subsequently in gardens at Columbus and Marietta. Near the latter place, the injury was quite great, cutting off all the later crop. Dr. Halsted [21]has reported upon this disease. He has noted its occurrence in New Jersey for three years [22]and regards it as a very serious trouble, but amenable to treatment with Bordeaux mixture. The injury caused by the leaf blight in the vicinity of Marietta suggests the need for watchfulness in tomato gardens. Should the leaf blight occur, Bordeaux spraying promises relief, and probably entire prevention, when begun early. The first spraying might well begin with blooming.

Another leaf spot, or blight, of tomatoes, that caused by the Alternaria (*Alternaria Solani* E. & M.), of potato early blight, has been known for some years among gardeners. The resemblance of these spots to those on the potato leaves will enable one to recognize the trouble. It is, usually, not so serious as the leaf blight (Septoria). Like it, the Alternaria may be prevented, should it become serious.

4. POINT ROT.

The rot of greenhouse tomatoes, at the point or blossom end, was a common trouble during the seasons of 1894 and 1895, in garden tomatoes. It has, also, been troublesome upon the forced plants in surface watered benches, while giving little trouble in sub-irrigated ones. Arthur[23] has reported upon this disease, but without definite results as to its cause.

Observations made for several seasons seem to show that this rot of green tomatoes is associated with insufficient moisture in the soil. The difference between the amount of rot in the surfaced watered and sub-irrigated benches, before referred to, was most striking. The amount of rot in the surfaced watered was inversely as the amount of water taken up

[20]There appears to be some question as to the identity of this with *Septoria Lycopersici* Speg.

[21]Report of Botanist N. J. Exp. Sta., 1895, p. 294.

[22]In letter, October, 1896.

by the soil. Similar results have been reported as secured by irrigation out of doors, during drouth. Insufficient moisture is, therefore, apparently a condition, if not a cause, of this form of green rot.

5. ANTHRACNOSE OF TOMATOES.

The spotting of tomatoes by the anthracnose fungus (*Glœosporium phomoides* Sacc.), may be expected. This disease has appeared at the Station upon one variety. The illustration, of badly affected fruits, was secured from Dr. Byron D. Halsted of the New Jersey Experiment Station.

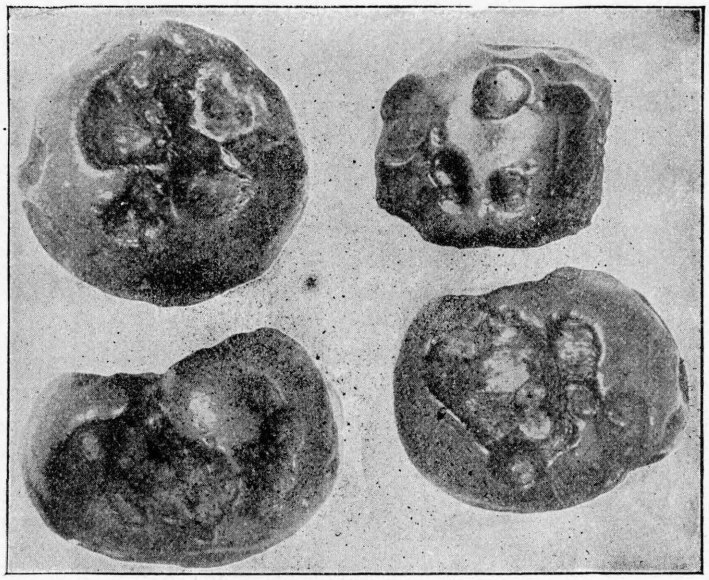

FIG. 5—TOMATO FRUIT ANTHRACNOSE.

Spraying with Bordeaux mixture may be useful for anthracnose, especially when it occurs with the leaf blight.

6. OTHER TOMATO FRUIT DISEASES.

There is a black rot of ripe tomatoes, and a rot produced by a pink mold fungus (Fusarium). These have been observed to occur. As yet no careful study has been made of them.

7. BACTERIAL TOMATO BLIGHT.

A damaging blight of tomatoes is reported from Clermont county among growers for the city markets. One, writing under date of July

[23]Arthur, J. C., 3d Annual Report, N. Y. Ex. Sta., 1884, pp. 379–80.

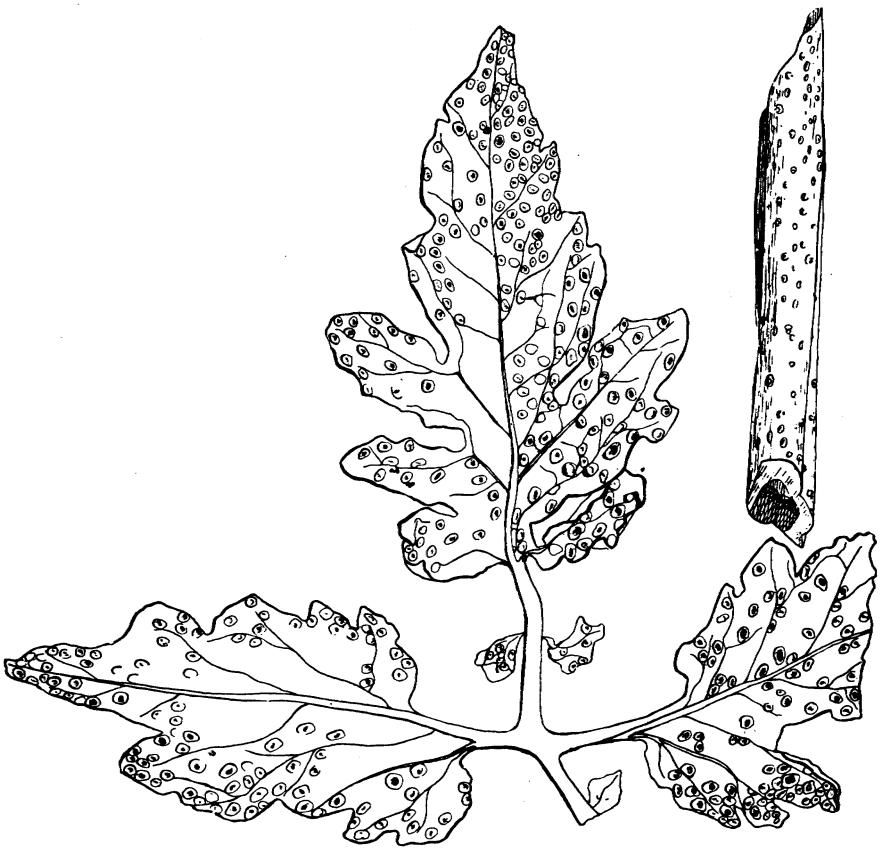

PLATE IV. TOMATO LEAF BLIGHT.

FIG. 1. Shows tomato leaflets spotted by the fungus *Septoria Lycopersici.*
FIG. 2. A section of stem similarly affected.
From drawings by Miss Detmers.

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23, 1896, says: "In my three acres there is scarcely a sound plant." This field had not previously been in tomatoes. Specimens of diseased plants were received at the station and examined. From very limited examination and study this was referred to bacterial blight. The plants sent for examination more commonly showed blighting and decay of a single shoot, or even of single leaves; less commonly the whole plant was blighted. The affected plants are described as showing "the drooping of the tip ends of the leaves, invariably only on one side of the plant at first."

Mounts made from the juices of the diseased specimens showed numerous rods, bacilli, and no fungus, or other parasite than this, was found upon them.

A bulletin by Dr. Smith,[24] has just come to hand. In this he describes "A Bacterial Disease of the Tomato, Egg plant and Irish potato," caused by *Bacillus, solanacearum* n. sp., which he shows to be distributed, in part, by insects. It is probable that the blight from Clermont county is the one he publishes upon. Whether it is or is not identical with it, the most indicated by present knowledge is in the line of preventive measures. I quote his summary of preventive measures for bacterial blight as covering this case: "(1) Early and complete destruction of insect pests; (2) early and complete removal of diseased vines; (3) in case of the potato, the prompt digging of the tubers and their immediate use or storage in a cold dry place; (4) selection of land, for subsequent planting, which has not been planted in egg plants, tomatoes or potatoes for several years; (5) selection of egg plant, tomato seed and potato tubers from plants growing in localities where the disease does not prevail."

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[24]Bulletin No. 12, U. S. Dept. Agriculture, Div. of Vegetable Physiology and Pathology, December, 1896.

SUMMARY.

1. The principal diseases of lettuce in Ohio appear to be rot, leaf perforation and downy mildew. Of these the rot is the most destructive.

2. Nematodes or eelworms have been found attacking a large variety of plants; they were very injurious to roses, begonias and forced cucumbers.

3. The only remedial measures that appear practical against nematodes in the forcing house are handling or sterilizing the earth used. This may probably be done either by freezing or by steaming.

4. The powdery mildew in greenhouse was successfully controlled upon Cinerarias by spraying. Carnations may also be sprayed without injury and with apparent good effect.

5. Bacterial wilt or blight, spot and downy mildew have been found upon cucumbers in the state. Also a new leaf blight of muskmelons and watermelon anthracnose.

6. Tomato leaf mold, point rot and an obscure forcing house blight have prevailed upon forced tomatoes. A new tomato leaf blight, a bacterial blight and anthracnose of tomatoes have appeared in gardens.

7. Of fungicides for such of these troubles as are produced by fungi, Bordeaux mixture promises to be most efficient (see pp. 232, 235, 236, 240). For several of the troubles named only preventive measures are known.